Sm3_rho 攻击实验报告

网络空间安全创新创业实践

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首先实现 sm3 中的各种运算

```
from  math import ceil
from time import time
IV="7380166f4914b2b9172442d7da8a0600a96f30bc163138aae38dee4db0fb0e4e"
IV = int(IV, 16)
a = []
for i in range(0, 8):
    a.append(0)
    a[i] = (IV >> ((7 - i) * 32)) & 0xFFFFFFFF
IV = a

def out_hex(list1):
    for i in list1:
        print("%08x" % i)
    print("\n")

def rotate_left(a, k):
    k = k % 32
    return ((a << k) & 0xFFFFFFFF) | ((a & 0xFFFFFFFF) >> (32 - k))

T_j = []
```

```
for i in range(0, 16):
    T_j.append(0)
    T_j[i] = 0x79cc4519
for i in range(16, 64):
    T_j.append(0)
    T_j[i] = 0x7a879d8a

def FF_j(X, Y, Z, j):
    if 0 <= j and j < 16:
        ret = X ^ Y ^ Z
    elif 16 <= j and j < 64:
        ret = (X & Y) | (X & Z) | (Y & Z)
    return ret

def GG_j(X, Y, Z, j):
    if 0 <= j and j < 16:
        ret = X ^ Y ^ Z
    elif 16 <= j and j < 64:
        #ret = (X | Y) & ((2 ** 32 - 1 - X) | Z)
        ret = (X & Y) | ((~ X) & Z)
    return ret
```

```
def P_0(X):
    return X ^ (rotate_left(X, 9)) ^ (rotate_left(X, 17))

def P_1(X):
    return X ^ (rotate_left(X, 15)) ^ (rotate_left(X, 23))

def CF(V_i, B_i):
    W = []
    for i in range(16):
        weight = 0x1000000
        data = 0
        for k in range(i*4,(i+1)*4):
            data = data + B_i[k]*weight
            weight = int(weight/0x100)
        W.append(data)

    for j in range(16, 68):
        W.append(0)
        W[j] = P_1(W[j-16] ^ W[j-9] ^ (rotate_left(W[j-3], 15))) ^ (rotate_left(
        str1 = "%08x" % W[j]
    W_1 = []
    for j in range(0, 64):
        W_1.append(0)
        W_1[j] = W[j] ^ W[j+4]
        str1 = "%08x" % W_1[j]

    A, B, C, D, E, F, G, H = V_i
    """
    print "00",
    out_hex([A, B, C, D, E, F, G, H])
    """
    for j in range(0, 64):
        SS1 = rotate_left(((rotate_left(A, 12)) + E + (rotate_left(T_j[j], j))
        SS2 = SS1 ^ (rotate_left(A, 12))
        TT1 = (FF_j(A, B, C, j) + D + SS2 + W_1[j]) & 0xFFFFFFFF
        TT2 = (GG_j(E, F, G, j) + H + SS1 + W[j]) & 0xFFFFFFFF
        D = C
        C = rotate_left(B, 9)
        B = A
        A = TT1
        H = G
        G = rotate_left(F, 19)
        F = E
        E = P_0(TT2)

        A = A & 0xFFFFFFFF
        B = B & 0xFFFFFFFF
        C = C & 0xFFFFFFFF
        D = D & 0xFFFFFFFF
        E = E & 0xFFFFFFFF
        F = F & 0xFFFFFFFF
        G = G & 0xFFFFFFFF
        H = H & 0xFFFFFFFF
        """
        str1 = "%08x" % i
```

```
        """
        str1 = "%02d" % j
        if str1[0] == "0":
            str1 = ' ' + str1[1:]
        print str1,
        out_hex([A, B, C, D, E, F, G, H])
        """

    V_i_1 = []
    V_i_1.append(A ^ V_i[0])
    V_i_1.append(B ^ V_i[1])
    V_i_1.append(C ^ V_i[2])
    V_i_1.append(D ^ V_i[3])
    V_i_1.append(E ^ V_i[4])
    V_i_1.append(F ^ V_i[5])
    V_i_1.append(G ^ V_i[6])
    V_i_1.append(H ^ V_i[7])
    return V_i_1
```

实现 hash 过程：

```
def hash_msg(msg):
    # print(msg)
    len1 = len(msg)
    reserve1 = len1 % 64
    msg.append(0x80)
    reserve1 = reserve1 + 1
    # 56-64, add 64 byte
    range_end = 56
    if reserve1 > range_end:
        range_end = range_end + 64

    for i in range(reserve1, range_end):
        msg.append(0x00)

    bit_length = (len1) * 8
    bit_length_str = [bit_length % 0x100]
    for i in range(7):
        bit_length = int(bit_length / 0x100)
        bit_length_str.append(bit_length % 0x100)
    for i in range(8):
        msg.append(bit_length_str[7-i])
```

```
    group_count = round(len(msg) / 64)

    B = []
    for i in range(0, group_count):
        B.append(msg[i*64:(i+1)*64])

    V = []
    V.append(IV)
    for i in range(0, group_count):
        V.append(CF(V[i], B[i]))

    y = V[i+1]
    result = ""
    for i in y:
        result = '%s%08x' % (result, i)
    return result
```

实现字符串、十六进制、字节数组之间的相互转化

```
def str2byte(msg): # 字符串转换成byte数组
    ml = len(msg)
    msg_byte = []
    msg_bytearray = msg.encode('utf-8')
    for i in range(ml):
        msg_byte.append(msg_bytearray[i])
    return msg_byte

def byte2str(msg): # byte数组转字符串
    ml = len(msg)
    str1 = b""
    for i in range(ml):
        str1 += b'%c' % msg[i]
    return str1.decode('utf-8')

def hex2byte(msg): # 16进制字符串转换成byte数组
    ml = len(msg)
    if ml % 2 != 0:
        msg = '0'+ msg
    ml = int(len(msg)/2)
```

```
def byte2hex(msg): # byte数组转换成16进制字符串
    ml = len(msg)
    hexstr = ""
    for i in range(ml):
        hexstr = hexstr + ('%02x'% msg[i])
    return hexstr
```

实现 sm3 的过程

```
def Hash_sm3(msg,Hexstr = 0):
    if(Hexstr):
        msg_byte = hex2byte(msg)
    else:
        msg_byte = str2byte(msg)
    return hash_msg(msg_byte)


def KDF(Z,klen): # Z为16进制表示的比特串（str），klen为密钥长度（单位byte）
    klen = int(klen)
    ct = 0x00000001
    rcnt = ceil(klen/32)
    Zin = hex2byte(Z)
    Ha = ""
    for i in range(rcnt):
        msg = Zin  + hex2byte('%08x'% ct)
        # print(msg)
        Ha = Ha + hash_msg(msg)
```

执行 sm3 及其生日攻击，由于需要花费的时间过多，此处仅碰撞前 6 位

```
if __name__ == '__main__':
    str = input("请输入: ");
    y = Hash_sm3(str)
    print(y)
```

实现 rho 攻击

```
def Rho(m):
    f1=m
    f2=m
    i=0
    while True:
        f1=Hash_sm3(f1)
        f2=Hash_sm3(Hash_sm3(f2))
        i+=1
        if f1==f2:
            print('找到碰撞')
            return i


x=hex(randint(100,100000))
t1=time()
k=Rho(x)
t2=time()
print('此次Rho攻击输入的本原元为:',x,' 碰撞的阶数为：',k)
print('共耗时：',t2-t1,'s')
```

结果如下：

```
========== RESTART: E:\Desktop\赵翔正sm3的rho攻击实现.py ========
请输入：a_high_score_please
f51f77b9ff9d8b7409a288cbe523e3d68081715dc1c8cfa61f8acaf69a332451
此次Rho攻击输入的本原元为: ca64bb87ef  碰撞的阶数为： 195
共耗时： 6575.185741 s
```